

### **Amendments to the Claims**

This listing of claims will replace all prior versions, and listings, of claims in the application:

### **Listing of Claims:**

1. (Currently amended) A method of performing two-dimensional Nuclear Magnetic Resonance (NMR) spectroscopy on a hyperpolarized sample, which method comprises the steps of:
  - hyperpolarizing a sample which comprises a first nuclear species (I) and a second nuclear species (S), with the Hamiltonian  $H = H_S + H_{IS} + H_I$  using DNP, wherein the NMR active nuclei receive hyperpolarization and transformation of the sample to a liquid state;
  - performing two-dimensional NMR spectroscopy on the sample and thereby producing at least two NMR spectra with the use of a sequence of rf-pulses, wherein the pulse pulse sequence comprises at least two rf-pulses, either on the same nuclei or on different nuclei, and wherein the pulse pulse sequence is adapted for a hyperpolarized sample in such a way that it uses a single scan, an efficient trajectory in a  $t_S$ - $t_{IS}$  plane and produces a square array of observed points in a square portion of a two time space, thereby producing at least two NMR spectra;
  - analysing the at least two ~~of the~~ NMR spectra in order to obtain a characterization of the sample. ~~, or to obtain an interim result to be used in the NMR spectroscopy step~~
2. (Cancelled)
3. (Cancelled)
4. (Cancelled))
5. (Cancelled)
6. (Cancelled)
7. (Cancelled)

8. (Cancelled)

9. (Cancelled)

10. (Cancelled)

11. (Cancelled)

12. (Cancelled)

13. (Cancelled)

14. (Currently amended) The NMR spectroscopy method according to claim 18, wherein the pulse sequence spans a trajectory in a two-dimensional evolution time space ( $t_S, t_{IS}$ ), said ~~in performed on a hyperpolarized sample which comprises a first nuclear spin species (I) and a second nuclear spin species (S)~~, the pulse sequence comprises the step of:

- (300) starting from the point (0,0), with an  $90^\circ$  pulse on S, observing N+1 points (i,i) up to point ( N,N);
- (305) performing a ~~pulse I~~ (i.e.  $180^\circ$  pulse on I), which leads to (N,-N);
- (310) waiting one time unit, leading to (N+1,-N+1);
- (315) performing ~~pulse IS~~ (a  $180^\circ$  pulse on both I and S), leading to (-N-1,-N+1);
- (320) observing points up to (N-2,N);
- (325) performing a  $180^\circ$  pulse on I, leading to (N-2,-N);
- (330) observing points up to (N+1,-N+3).

15. (Currently amended) The NMR spectroscopy method according to claim 1, wherein the pulse sequence spans a trajectory in a two-dimensional evolution time space ( $t_S, t_{IS}$ ), said ~~in performed on a hyperpolarized sample which comprises a first nuclear spin species (I) and a second nuclear spin species (S)~~, the pulse sequence comprises the step of:

- (300b) starting from the point (0,0), with an  $90^\circ$  pulse on S, observing N+1 points (i,i) up to point ( N,N);
- (305b) performing a ~~pulse I~~ (i.e.  $180^\circ$  pulse on I), which leads to (N,-N);
- (310b) waiting one time unit, leading to (N+1,-N+1);

- (315b) performing a ~~pulse IS~~ (a  $180^\circ$  pulse on both I and S), leading to  $(-N-1, -N+1)$ ;
- (320b) observing points up to  $(N-2, N)$ ;
- (340b) performing a  $180^\circ$  pulse on S, which reverses both time signs and leads to  $(-N+2, -N)$ ;
- (345b) observing points up to  $(N, N-2)$ ;
- (350b) performing a  $180^\circ$  pulse on I leading to  $(N, -N+2)$ ;
- (355b) observing points up to  $(N+1, -N+3)$ .

16. (New) A method of performing two-dimensional Nuclear Magnetic Resonance (NMR) spectroscopy on a hyperpolarized sample, which method comprises the steps of:

- hyperpolarizing a sample which comprises a first nuclear species (I) and a second nuclear species (S), with the Hamiltonian  $H = H_S + H_{IS} + H_I$  using DNP, wherein the NMR active nuclei receive hyperpolarization and transformation of the sample to a liquid state;
- performing two-dimensional NMR spectroscopy on the sample and thereby producing at least two NMR spectra with the use of a sequence of rf-pulses, wherein pulse sequence comprises at least two rf-pulses on different nuclei, and wherein pulse sequence is adapted for a hyperpolarized sample in such a way that it uses a single scan, an efficient trajectory in a  $t_S$ - $t_{IS}$  plane and produces a square array of observed points in a square portion of a two time space,;
- analyzing the at least two NMR spectra in order to obtain a characterization of the sample.

17. (New) The NMR spectroscopy method according to claim 16, wherein the pulse sequence spans a trajectory in a two-dimensional evolution time space ( $t_S$ ,  $t_{IS}$ ), said pulse sequence comprises the step of:

- (300) starting from the point  $(0,0)$ , with an  $90^\circ$  pulse on S, observing  $N+1$  points  $(i,i)$  up to point  $(N,N)$ ;
- (305) performing a  $180^\circ$  pulse on I, which leads to  $(N, -N)$ ;
- (310) waiting one time unit, leading to  $(N+1, -N+1)$ ;
- (315) performing a  $180^\circ$  pulse on both I and S, leading to  $(-N-1, -N+1)$ ;

- (320) observing points up to (N-2,N);
- (325) performing a  $180^\circ$  pulse on I, leading to (N-2,-N);
- (330) observing points up to (N+1,-N+3).

18. (New) The NMR spectroscopy method according to claim 16, wherein the pulse sequence spans a trajectory in a two-dimensional evolution time space ( $t_s$ ,  $t_{IS}$ ), said pulse sequence comprises the step of:

- (300b) starting from the point (0,0), with an  $90^\circ$  pulse on S, observing N+1 points (i,i) up to point ( N,N);
- (305b) performing a  $180^\circ$  pulse on I, which leads to (N,-N);
- (310b) waiting one time unit, leading to (N+1,-N+1);
- (315b) performing a  $180^\circ$  pulse on both I and S, leading to (-N-1,-N+1);
- (320b) observing points up to (N-2,N);
- (340b) performing a  $180^\circ$  pulse on S, which reverses both time signs and leads to (-N+2,-N);
- (345b) observing points up to (N,N-2);
- (350b) performing a  $180^\circ$  pulse on I leading to (N,-N+2);
- (355b) observing points up to (N+1,-N+3).